serious loss. Although no commutator for this special purpose is at present on the market, the solution of the problem has been practically achieved, and may be expected in the immediate future to result in important developments in the electrical distribution of power.

With both the continuous current and the alternating current of low frequency, then, for use at the far end of the lines of suitable pressure, the pressure having been reduced from that on the line wires by transformers, as at the transmitting end it was increased, continuous current motors can be used for power work where most suitable; the current can be used for electro-metallurgical work and for electric lighting in the ordinary well-known ways, and the alternating current can be used in motors direct, without rectification, everywhere else.

Already a great number of applications for power have been made. As before noted, the Pittsburg Reduction Company has started works for the production of aluminium, and will be supplied with power to the extent of, at present, 7000 h.p., at 150 volts. The Niagara Falls Paper Company have erected a mill on the lands of the Power Company, for the making of their wood-pulp, and have sunk their own pit for turbines to the extent of 6000 h.p. The Company will take water from the main canal, and lease the right to use the great tunnel of the Niagara Falls Power Company as a tail-race. This mill, as a power consumer, is representative of a type which will probably use largely the cheap power at the Falls, needing as they do power continuously day and night. Synchronising alternators, as motors, could with effect be used in such cases, hardly ever requiring stopping and starting as they would; and they are of high efficiency. The high pressure might be used in some of these cases, without transforming down, in addition. Applications for power have also been made from Albany, 350 miles from the Falls.

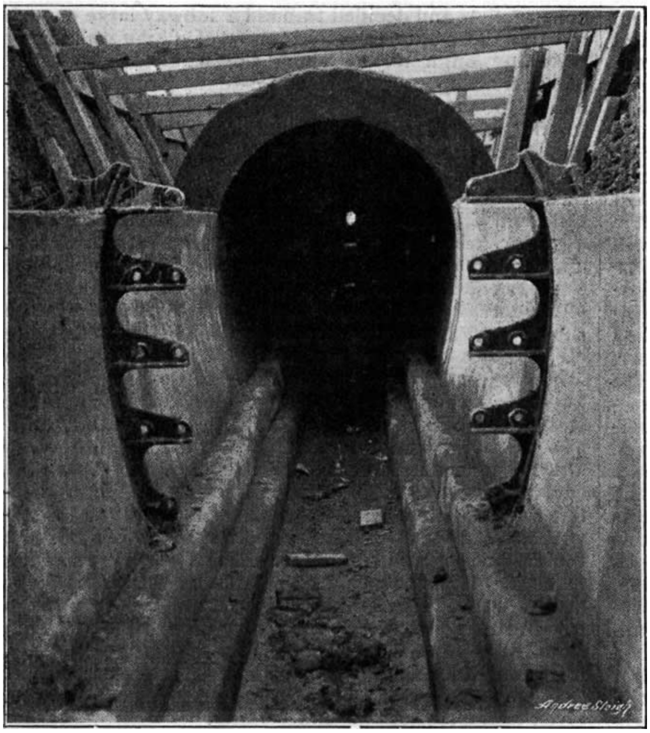

FIG. 4

Large as is the extent of the operations described above, it is by no means all that is in contemplation, or even being now prosecuted. On the same side of the Falls, rights of way have been obtained for driving a second tunnel, of the same capacity as the first—namely, 100,000 h.p.—and on the Canadian side powers have also been granted to the Company to use the water-power there, the extent contemplated to which it will be used reaching, it may be, 250,000 h.p. Altogether the total amount for which concessions have been granted amounts to 450,000 h.p., which will involve the abstraction from the Falls of about 12 per cent. of the water. But, large as this may seem at first sight, admirers of the Falls, from the æsthetic point of view, will be glad to hear that it is thought that the diversion of this amount will not be noticeable to visitors to the Falls. And the Niagara Falls Power Company have limited their demands on the side above the American Falls to the 200,000 h.p. It will no doubt be a long time before the full amount for which powers have been obtained will be taken up. What may lie in the future it is impossible to forecast. But, so far, lovers of nature need fear little that they will be deprived of this great work of hers; they will still hear its thunder, be able to watch its ceaseless changing aspects, and revel in the other beauties of this mighty cataract.

NOTES.

THE first (or gentlemen's) soirée of the Royal Society is announced for Wednesday, May 2.

THE Duke of Bedford and Mr. Spencer Pickering, F.R.S., have arranged to start an experimental fruit station, in order to investigate both scientifically and practically the culture of hardy fruits. About twenty acres of land in the neighbourhood of Woburn Abbey have been set apart for the experiments, and the services of an able horticulturist, who will act as local manager, have been secured.

PROF. J. J. SYLVESTER, F.R.S., has been elected one of the twelve foreign members of the Italian Scientific Academy, founded in 1782, called "Dei Quaranta." Among the other foreign members of this Academy are Prof. Helmholtz, Lord Kelvin, Prof. Huxley, and M. Pasteur.

DR. J. R. REYNOLDS, F.R.S., has been re-elected President of the Royal College of Physicians.

THE death is announced of Dr. E. H. Jacob, Professorof Pathology in Yorkshire College, Leeds, at the early age of forty-four.

THE death occurred last week of General Favé, Academicien Libre of the Paris Academy of Sciences, and for a long time head of the Ecole Polytechnique, where he was Professor of Military Art and Fortification.

WE regret to record the death of Mr. W. Pengelly, F.R.S., at Torquay, on Friday last, at the age of eighty-two. He was the author of various papers on geological and other subjects, and his exploration of Kent's Cavern, carried out under the auspices of the British Association, was of extreme importance in establishing the existence of prehistoric man. He also accumulated and arranged a fine collection of Devonian fossils, which, under the name of the Pengelly Collection, are now in the Oxford University Museum. The President and Committee of the Torquay Natural History Society intend to appeal to the scientific world for funds to build a new lecture-room to their museum, to be called the Pengelly Memorial. Mr. Pengelly was the founder of the Society, and acted as secretary for forty years.

IT is stated that the Municipal Council of Bry-sur-Marne, near Paris, has decided to erect a monument to Daguerre, the inventor of photography.

A CHAIR of Bacteriology is to be established at Erlangen, and Dr. Hauser, now Privat-docent in that University, will, the *British Medical Journal* states, probably be invited to occupy it.

THE legacy of 100,000 francs, placed at the disposal of the French Government by M. Giffard, has been assigned by the Minister of Public Instruction to the laboratory of the International Society of Electricians.

MR. SCOTT ELLIOT, who left England for Uganda last September, reached Usoga, on the northern shore of the Victoria Nyanza, in December. He proposes to explore the botany, geology, and natural history of the great mountain chain of Ruwenzori.

THE *Ceylon Observer* reports that at the annual meeting of the Planters' Association, held at the end of last month, it was resolved "that the Government be asked to arrange for the appointment of an entomologist to be attached to the Colombo Museum."

THE tenth congress organised by the National Horticultural Society of France will be held at Paris during the General Horticultural Exhibition, between May 23 and 28. Among the special questions to be discussed are the following:—Chlorophyll in relation to the vigour of cultivated plants; capillarity in relation to the preparation of the soil; the means of promoting the nitrification of nitrogenous substances, and of rendering the nitrogen more readily assimilable.

A REUTER'S telegram states that Mr. Theodore Bent and his party, on their return from their archæological expedition to Hadramaut, had reached the coast at Sheher, east of Makalla, on March 3. All were in good health, but the journey seems to have been accompanied by considerable danger. They were attacked on several occasions by hostile tribes, but appear to have made good use of their time traversing and, doubtless, mapping a large area of the interior.

THE annual dinner of the Institution of Civil Engineers was held on March 17, in Merchant Taylors' Hall. Mr. Alfred Giles occupied the chair, and among those present were Lord Kelvin, Sir F. Abel, Sir George Stokes, Sir F. Bramwell, Sir Douglas Galton, Sir John Fowler, Prof. Kennedy, Mr. J. W. Hulke, Sir R. Rawlinson, Mr. Alex. Siemens, Dr. James Riley, and Dr. Pole. The institution now numbers as many as 6000 members, and has offshoots in various branches of the engineering profession—marine engineers, naval architects, iron and steel founders, telegraph engineers, &c.

THE following are among the lecture arrangements at the Royal Institution after Easter:—Prof. J. A. Fleming, four lectures on "Electric Illumination"; Prof. J. W. Judd, three lectures on "Rubies: their nature, origin, and metamorphoses"; the Rev. W. H. Dallinger, three lectures on "The Modern Microscope"; Prof. Dewar, three lectures on "The Solid and Liquid States of Matter"; Mr. John A. Gray, two lectures on "Life among the Afghans"; Capt. Abney, three lectures on "Colour Vision" (the Tyndall Lectures). The Friday evening meetings will be resumed on April 6, when a discourse will be given by Prof. Victor Horsley on "Destructive Effects of Projectiles"; succeeding discourses will probably be given by Prof. J. J. Thomson, Dr. J. G. Garson, Prof. H. Marshall Ward, Dr. G. Sims Woodhead, Prof. A. M. Worthington, Sir Howard Grubb, Prof. Oliver Lodge, Prof. C. V. Boys, and others.

THE Committee appointed by the Secretary of State to inquire into the best means available for identifying habitual criminals have issued their report. The system of identification recommended for adoption embodies the practical results of Mr. Galton's investigations, and M. Bertillon's system of classification. It is proposed (1) to photograph prisoners as at present, stress being laid on the necessity of obtaining a perfectly clear side photograph showing distinctly the profile and the form of the ear. (2) To take the five measurements required for purposes of classification, namely, the length of the hand, the width of the head, the length of the left middle finger, the length of the left forearm, the length of the left foot. The measurements should be taken with the same instruments as in France, and should be stated in millimetres, so as to facilitate identification in international cases. (3) To take the finger-prints by Mr. Galton's method. (4) A description should also be taken as at present, but somewhat briefer, including the height in feet and inches, colour of hair, eye and complexion, and the distinctive marks. To carry out these suggestions the establishment of an Anthropometrical Registry is proposed. The Committee are strongly of opinion that it is essential to the complete success of the registry to secure the services of an expert practised in the methods of scientific anthropometry. It is certainly desirable that the English Anthropometric Office should from the first have the advantage of scientific guidance not inferior to that enjoyed by the French Service d'Identification.

M. MARCEL DUBOIS, in a series of articles recently concluded in the *Annales de Géographie*, has investigated the classification of rivers according to size. He points out the unscientific nature of a classification by length or volume alone, and proposes, in place of the uncertain methods hitherto employed, to classify river-systems according to the ratio which the whole annual discharge bears to the area of the drainage basins. This permits of a sub-classification according to climatic zones and varieties of vertical relief. Thus tropical islands have the largest rivers of all, on account of the great rainfall and the small area of the land. Peninsulas in tropical regions come next, but when great continents are considered the configuration of the land comes very prominently into play. Thus in Africa the plateau-structure favours a storing-up of rainfall in lakes and in the upper-courses of rivers barred by cataracts, while in South America the vast plain of the Amazon presents on the grandes scale a system of direct drainage, the whole water-supply flowing without interruption to the sea.

THE *Illustrated Archæologist* for March retains the high character of its predecessors as regards the number and quality of the illustrations. Mr. Edward Lovett's article on prehistoric man in Jersey contains figures of flake-knives, scrapers, drills, piercers, spear-heads, and arrow-heads of flint found in a cave in the high and rugged cliffs near Plemont and Greve-de-Lecq. The height of the cave-floor above the present sea-level is sixty feet. Some exceedingly interesting objects were obtained from a layer of very dark-coloured carbonaceous matter found on the floor, and representing the remains of the last fire used in this ancient dwelling-place. They consisted of several calcined shells of the common limpet, some fragmentary remains of bone, and a few molar teeth of a cervine animal. The most interesting find in the ash, however, was a calcined nodule of iron pyrites which had probably been used with a flint flake for making the necessary spark to kindle the fire. This carries the flint-and-steel back to a very remote period, and gives a hoary antiquity to the tinder-box or its contents. In the whitish clay on the floor of the cave more than a thousand flints were found, every one of which bore, more or less, abundant traces of careful chipping or flaking. The implements described and figured by Mr. Lovett do not belong to a highly-finished type; indeed, from the enormous number of flakes and chippings associated with them, it is highly probable that the cave was a neolithic workshop. The opinion is expressed that, at the time when the cave was inhabited, Jersey was probably joined to France, and perhaps France to England, which may explain the presence of chert from Portland.

THE current number of *L'Astronomie* contains an article by M. J. R. Plumandon on the application of meteorology to the art of war. The author quotes a number of passages from works of military history, showing how a foreknowledge of the weather for a day or so in advance would probably have changed the issue of certain engagements. With the view of facilitating weather predictions, and of utilising them for military purposes, the author has invented a meteoroscope, which is made by M. Richard, of Paris; it is an aneroid having a dial giving 160 simple predictions according to the reading of the barometer, the wind direction (as shown by the clouds), and the season. It is apparently similar in principle to a synoptic table published by the author some years ago, in which an index, when made to point to the wind direction, gave at right angles the direction of the centre of low pressure (Buys Ballot's law), then in concentric circles was given the probable weather for certain barometric conditions and for the particular season, based upon average conditions obtained from a large number of actual cases. The plan is founded upon scientific principles, but the apparatus can only be regarded as a popular indicator of possible changes in accordance with certain general types of weather.

MR. J. J. HICKS has sent us an account and some readings of Bartrum's open-scale barometer. The lower part of the instrument is like an ordinary mercurial barometer, and near the upper surface of the mercury the tube is enlarged, while above the surface it is again reduced and continued upwards for a length of 27 inches or more. The narrow tube above the mercury contains a red fluid, the upper end of which gives the barometer reading; a rise of mercury in the enlarged part of the tube causing a much greater rise of the fluid in the upper tube. The arrangement is very ingenious, and the readings agree well with the mercurial barometer reduced to a temperature of 62°, after the application of certain corrections, but we do not see why the correction should not be altered to agree with the standard temperature of 32° instead of 62°. By the adoption of artificial inches, and adjustment at some neutral point, the error for capacity might possibly be eliminated. An inch of mercury is represented on the scale by about 9 inches, and it is claimed that this long range enables a reading to be taken to one-thousandth of a mercurial inch without a vernier. The instrument appears to be more reasonable and accurate than other large scale barometers hitherto introduced, and is certainly more handy.

THE best method of using oil in calming troubled waters is thoroughly investigated in a pamphlet entitled "Die Lehre von der Wellenberuhigung," written by Dr. M. M. Richter. The author calls attention to a fact of paramount importance, viz. that the quieting effect of all oils or soaps used is in direct proportion to the amount of free oleic acid they contain. The chief desiderata in an efficient material for the purpose are chemical and physical stability, safety, and speed of expansion over the surface of the water. Such a substance would be found in free oleic acid dissolved in methyl or hexyl alcohol. The advantage of the alcohol is twofold. It prevents the solidification of the oleic acid at 4° C., and it greatly increases the rate of expansion. The latter depends, as the author shows, not so much upon a difference of surface tension as upon the solubility of the expanding surface in water. The observed fact that the more viscous oils are more effective than the more mobile ones, is accounted for by the process of manufacture. Olive oil is prepared by pressing out the olives in the cold, while the various fish oils are prepared at high temperatures, and are much more efficient, owing to the decomposition of the oleic glyceride into glycerine and free oleic acid. But to save the prejudices of experienced navigators, who have found the more viscous oils answer their purpose better, Dr. Richter recommends that the oleic acid mixture be kept as viscous as possible. The force with which a drop of oleic acid spreads over the surface of sea water is sufficient to arrest the motion of a log of wood weighing as much as fifteen grams, when blown by a fairly strong wind, and even to start it in the opposite direction.

AT a recent meeting of the Société Française de Physique, M. Pellat read a paper on the point of application of electromagnetic forces. In the classic experiment of Foucault, where a disc of copper turns between the poles of a magnet, the electromagnetic forces acting on the induced currents, which are developed in the moving disc, do not perform any work, as can be seen from the following consideration. If we rotate the disc by expending an amount of work W, say by means of a falling weight, when the driving force ceases to act, the disc will be rapidly brought to rest. If now the disc is brought back to its initial state by the removal of the quantity of heat Q which has been developed, then $T = JQ$ where T is the total work done by external forces on the system (disc). Now T is made up of two parts: (1) the work W supplied by the falling weight, (2) the work (x) performed by the electromagnetic forces (also external forces, since we are not considering the magnet as forming part of the system under consideration). Therefore $W + x = EQ$; but Violle has shown that $W = JQ$, hence $x = 0$, or the work done by the electromagnetic forces is zero. If, as is usually done, we suppose that the electromagnetic forces act on the matter conveying the electric currents (in this case the disc), then the resultant of these forces is so directed that if the point of application were displaced during the rotation they would perform a negative amount of work. Hence since $x = 0$ the point of application of the electromagnetic forces does not move as the disc rotates. If, however, we suppose that the electric current is the point of application of the electromagnetic forces, then, as has been shown by Nobili, Antinori, and Matteucci, the position of the induced currents being fixed with reference to the magnet, there will be no work done by these electromagnetic forces. To explain how the energy of rotation of the disc becomes converted into heat, it is sufficient to admit that the induced currents (whose positions are fixed in space) exert a kind of friction on the moving disc. The following mechanical device is mentioned by the author as giving a representation of what happens in the electrical case: a copper disc D has its opposite faces pressed between the two arms of a clip P in such a manner that if the clip is held the disc turns with some friction. If the disc and clip are set in movement by the expenditure of an amount of external work W, then, if nothing prevents it, the clip will be dragged round by the disc. If, however, a pin B is placed so that the clip cannot rotate, then the disc will lose its energy of rotation, which will be converted into heat by the friction of the clip. The external force which has acted, *i.e.* the pressure exerted by B on the clip, has performed no work since its point of application has not moved. The quantity of heat developed in the disc and clip will be the equivalent of the work W spent in putting the disc in rotation. Thus the clip represents the induced currents in Foucault's experiment, and the pressure exerted by the pin B on the clip represents the electromagnetic force.

A COPY of the "Handbook of Jamaica," published by Mr. Edward Stanford, has been received. The work is now in its fourteenth year of publication, and comprises statistical, historical, and general information concerning the island, compiled from official and other trustworthy records by Mr. S. P. Musson and Mr. T. Lawrence Roxburgh.

WE have received the first number of a new journal published at Oporto, and entitled *Annaes de Sciencias Naturaes.* The articles are mostly written in Portuguese, and among them we notice one on the flora of Oporto, and another on the birds of Portugal, as well as numerous notes on natural science matters.

MESSRS. MACMILLAN AND CO. have issued the thirty-first volume of the "Statesman's Year-Book," edited by Mr. J. Scott Keltie. The statistics have been well revised, and renewed in cases where recent information rendered such a course desirable. These changes, and the many additions that have been made, bring the volume in touch with current topics and maintain its character as an indispensable work of reference on all statistical and historical matters relating to the States of the world.

SEVERAL new crystallised compounds of hydroxylamine with the chlorides and sulphates of cobalt and manganese have been isolated by Dr. Feldt in the laboratory of the University of Berlin. The chlorides are analogous to the salts containing zinc, cadmium, and barium described some few years ago by Crismer, being constituted upon the type $RCl_2.2NH_2OH$. The sulphates, however, only contain one molecular equivalent of hydroxylamine, but contain two molecules of water of crystallisation. The compound $CoCl_2.2NH_2OH$ is obtained by digesting in a flask through which a current of hydrogen is passing, and which is heated by a water bath, an alcoholic solution of cobaltous chloride with four molecular equivalents of hydroxylamine hydrochloride and a few cubic centimetres of an alcoholic solution of free hydroxylamine. Air requires to be excluded, as brown subsidiary products are otherwise produced. The liquid after a short time deposits the new compound in beautiful rose-coloured acicular crystals, which are fairly stable, and may be preserved for months out of contact with the air. They detonate somewhat violently, however, when heated, owing to sudden decomposition. The manganese salt $MnCl_2.2NH_2OH$ may be similarly obtained, and is more stable than the cobaltous compound. It explodes at 160°. The sulphates cannot be prepared in alcoholic solution, owing to the sparing solubility of the constituent sulphates in alcohol. By employing aqueous solutions salts of a similar nature are obtained, but with the difference of composition above mentioned. Both the salts $CoSO_4.NH_2OH.2H_2O$ and $MnSO_4.NH_2OH.2H_2O$ are similar in appearance to the chlorides, and are considerably more stable in their nature. The most interesting of Dr. Feldt's preparations, however, is a salt $CoCl_3.6NH_2OH$, analogous to the well-known luteo-cobalt-ammonium chloride. When aqueous or alcoholic solutions of cobaltous chloride and hydroxylamine are mixed in contact with air, the rose-coloured precipitate rapidly darkens, taking up oxygen in all probability to form the compound $CoOCl.2NH_2OH$. If this substance is suspended in strongly cooled alcohol, and a similarly cooled alcoholic solution of hydrochloric acid is allowed to fall slowly in, a dark green liquid is produced, which eventually deposits a yellow crystalline powder. This precipitate dissolves readily in dilute aqueous hydrochloric acid, and the solution yields on evaporation the luteo-salt in large, well-formed, bronze-coloured crystals belonging to the monoclinic system. This somewhat remarkable compound is a particularly stable substance, which yields a crystalline precipitate of the corresponding oxalate, $Co_2(C_2O_4)_3.12NH_2OH$, upon the addition of ammonium oxalate solution. Full details of the work are contributed to the *Berichte.*

THE publisher of "Der Botanische Garten zu Buitenzorg auf Java," and "Eine Botanische Tropenreise, Indo-malayische Vegetationsbilder und Reiseskizzen," noticed in these columns last week, is W. Engelmann, of Leipzig.

THE additions to the Zoological Society's Gardens during the past week include a Diana Monkey (*Cercopithecus diana* ♀) from West Africa, presented by Miss L. D. Summerbell; a Wild Cat (*Felis catus* ♀) from Inverness-shire, presented by Mrs. Ellice; two Collared Peccaries (*Dicotyles tajaçu* ♀ ♀); a Globose Curassow (*Crax globicera* ♂) from British Honduras, presented by H.C. Sir Alfred Molony, K.C.M.G.; two Cape Bucephalus (*Bucephalus capensis*); a Cape Viper (*Causus rhombeatus*) from South Africa, presented by Mr. J. E. Matcham; two Crossed Snakes (*Psammophis crucifer*); a Smooth-bellied Snake (*Homalosoma lutrix*); a Rhomb-marked Snake (*Psammophylax rhombeatus*) from South Africa, presented by Messrs. H. M. and C. Beddington; a Crossed Snake (*Psammophis crucifer*); a Hoary Snake (*Coronella cana*); a Puff Adder (*Vipera arietans*) from South Africa, deposited.

OUR ASTRONOMICAL COLUMN.

COMET-SPECTRA AS AFFECTED BY WIDTH OF SLIT.—The unaccountable differences between the spectrum of burning or electrically glowing carbon and the carbon bands observed in comets are successfully explained by Prof. H. Kayser in the *Astronomische Nachrichten.* The chief differences observed between the cometary and terrestrial spectra are the following:—The carbon flutings in the laboratory have a bright edge on the red side, which in the comet spectrum is displaced towards the red. But the maximum of luminosity in the latter is more refrangible than the bright edge in the former. Whereas in the true carbon spectrum the first fluting is the brightest, in cometary spectra the second has often appeared brighter than the first. It is suggested that all these anomalies are due to the fact that in astronomical spectroscopy the slit cannot be closed so far as in the laboratory, when the objects observed are as faint as comets usually are. If we suppose the true spectrum to be that produced by a very narrow slit, we may reproduce the impure cometary spectrum by sliding a wide slit along the true spectrum, and adding up for every position the strips of the true spectrum covered by the slit. We shall thus obtain the portion of the impure spectrum corresponding to the centre of the slit. When the wide slit encounters a band with a bright edge towards the red, it will at once begin to indicate a brightness, which will gradually increase until the slit is completely filled with light. The maximum will then have been obtained, and we see that it does not correspond to the bright edge, but to a line within it. Thus the first two anomalies are accounted for. Finally, if the slit is so wide that it comprehends two carbon bands at the same time, the maximum will not be obtained when the first or the second band occupies its centre, but when the first is just leaving and the third just entering. This accounts for the third anomaly. The experiment may be easily performed in the laboratory, by observing the arc spectra of calcium or iron. On widening the slit the line spectra of these elements show the same positions for the widened lines, but the carbon bands are diffused towards the red, and their maxima are displaced towards the violet.

THE ASTIGMATISM OF ROWLAND'S CONCAVE GRATINGS.—The astigmatism of the Rowland concave grating gives to this form of spectroscope the advantage of showing no dust lines along the spectrum, and of broadening out the spectrum of a star or a small electric spark into a band; but the same property makes it unsuitable for the simultaneous observation of two spectra by the usual method of illuminating one part of the slit with one source of light, and the other part with another source. By a special device, Prof. Rowland has no difficulty in obtaining photographic comparison spectra, but his method only holds good for photography. In a recent pamphlet by Dr. J. L. Sirks (Amsterdam: Johannes Müller), however, it is shown that a slight modification of the ordinary method will enable the desired comparison to be made, at least in the first and second order spectra. The comparison prism, or equivalent arrangement for introducing a second source of light, needs only to be placed some distance from the slit, at a point de-